REMARKS

Claims 1 to 5, 7, 8, and 10 to 28 are pending in the application, of which claims 1, 13, 19, and 28 are independent.[1] Favorable reconsideration and further examination are respectfully requested.

Initially, the title was objected to. Accordingly, Applicants have changed the title in the accompanying substitute specification to a title that is close to that kindly suggested by the Examiner. Approval of the new title is respectfully requested.

Claims 1 to 20 were rejected under §§101 and 112 for allegedly claiming two different statutory classes of invention in the same claim. It was said that the counter-doping the first doping layer only occurs when the transistor is in operation. In particular, it was said that this constitutes the depletion region. Applicants respectfully disagree, and point the Examiner, e.g., to page 3, lines 20 et seq., which describe diffusing the pentavalent doping into the base layer. There is no mention of transistor operation during that process. Furthermore, Applicants respectfully direct the Examiner to the attached Web page from wikipedia.org, which describes the depletion region forming absent an electric field (i.e., operation of the transistor), and what happens to the depletion region in the presence of an electric field.

In view of the foregoing, Applicants submit that the claims are not directed to two statutory categories and, therefore, request withdrawal of the §§101 and 112 rejections.

Claims 1 to 17, 19 and 20 were rejected over WO01/91162 (Asai)[2]; and claim 18 was rejected over Asai in view of U.S. Patent No. 5,140,400 (Morishita). As shown above,

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[1] The Examiner is urged to independently confirm this recitation of the pending claims.
[2] The English-language counterpart to Asai is EP1263052, which was cited in the IDS filed with this application.

Applicants have incorporated the subject matter of prior dependent claim 6 into the independent claims. In view of these amendments, withdrawal of the art rejections is respectfully requested.

In particular, each of the independent claims was amended to recite that the base layer comprises carbon atoms having a concentration greater than 1×10^{18} cm^{-3}. It was said on page 5 of the Office Action (referring to Asai) that "the base layer (111) comprises carbon atoms having a concentration greater than E18cm^{-3}. (See Fig. 13)". As understood by Applicants, paragraphs 0097 to 0100 of the English-language version of Asai describe the use of carbon in the base layer. However, there is no disclosure or suggestion whatsoever that the carbon has a concentration greater than 1×10^{18} cm^{-3}, nor is there any specific reference in Asai to that concentration. In fact, Applicants submit that it would not have been obvious to use this carbon concentration in the base layer. More specifically, as described in page 8, lines 18 et seq. of the specification, this carbon concentration essentially reduces the diffusion of the trivalent substance (e.g., boron), thereby reducing the width of the base layer. In order to obtain effective reduction of boron diffusion, the carbon atoms are located at lattice points, e.g., at positions that are otherwise occupied by atoms of the material of the base layer. Consequently, the layer growth of the base layer takes place at lower temperatures, which may result in a lower growth rate and a longer manufacturing process -- two effects which those in the art try to avoid.

For at least the foregoing reasons, independent claims 1, 13, 19, and 28 are believed to be patentable over the art.

Each of the dependent claims is also believed to define patentable features of the invention. Each dependent claim partakes of the novelty of its corresponding independent claim and, as such, has not been discussed specifically herein.

It is believed that all of the pending claims have been addressed. However, the absence of a reply to a specific rejection, issue or comment does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above may not be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

In view of the foregoing amendments and remarks, the entire application is believed to be in condition for allowance, and such action is respectfully requested at the Examiner's earliest convenience.

Finally, Applicants are submitting herewith a copy of the originally signed declaration to substitute for the copy currently on file. In the copy currently on file, the U.S. serial number and filing date were added post-signing.

Please apply any additional fees due for this Amendment to deposit account 06-1050, referencing Attorney Docket No. 14603-007US1.

Respectfully submitted,

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Depletion region

From Wikipedia, the free encyclopedia
(Redirected from Depletion layer)

In semiconductor physics, the **depletion region**, also called **depletion layer** or **depletion zone**, as well as the **junction region** or the **space charge region** is an insulating region within a conductive, doped semiconductor material where the charge carriers have diffused away or have been swept away by an electric field. Understanding the depletion region is key to explaining modern semiconductor electronics: the operation of diodes, bipolar junction transistors, field effect transistors, and variable capacitance diodes rely on depletion region phenomena.

Conceptual overview

The depletion region forms across the P-N junction when the junction is in thermal equilibrium, *i.e.* things are in a steady state.

Electrons and holes will diffuse into regions with lower concentrations of electrons and holes, much as ink will diffuse into water until it is uniformly distributed throughout. N-type semiconductor has an excess of free electrons, and P-type has an excess of holes. Therefore when N-doped and P-doped pieces of semiconductor are placed together to form a junction, electrons will diffuse into the P side and holes will diffuse into the N side. However when a hole and an electron come into contact, they eliminate each other through recombination. This bares the donor atoms adjacent to the depletion region, which are now charged ions. The ions are positive on the N side and negative on the P side, creating an electric field that counteracts the continued diffusion of charge carriers. When the electric field is sufficient to repel incoming holes and electrons, the depletion region reaches its equilibrium width. Integrating the electric field in the depletion region gives what is known as the built-in potential (also called the junction voltage or barrier voltage).

Under reverse bias (P negative with respect to N) this potential is increased, further widening the depletion zone. Forward bias (P positive with respect to N) narrows the zone and eventually reduces it to nothing, making the junction conductive and allowing free flow of charge carriers.

The depletion region is so named because it is void of all majority carriers. In other words, the recombination of holes and electrons at the P-N junction causes the region to become depleted of mobile charge.

See Also

- Capacitance voltage profiling

Retrieved from "http://en.wikipedia.org/wiki/Depletion_region"

Category: Semiconductors

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